SCIOTOVILLE BRIDGE

McClintic-Marshall Company

SCIOTOVILLE BRIDGE

Over the Ohio River at Sciotoville, Ohio

FOR

The Chesapeake & Ohio Northern Railway Company

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STEEL SUPERSTRUCTURE

MANUFACTURED AND ERECTED BY

McClintic-Marshall Company

Paul L. Wolfel, Chief Engineer · Elbert A. Gibbs, Manager of Erection

PITTSBURGH · PENNSYLVANIA

THE SCIOTOVILLE BRIDGE

THE Chesapeake and Ohio Northern Railway is a branch of the Chesapeake & Ohio Railway Company connecting the main line of the latter on the Kentucky side of the Ohio River with the Hocking Valley Railway at Columbus, Ohio. The new line was projected for heavy freight traffic, principally coal trains.

The Ohio River is crossed at Sciotoville about 120 miles above Cincinnati. The bridge is the most important piece of work on the new line. The steel structure has a total length of 3,435 ft., consisting of two main channel spans of 775 ft. each, a south (Kentucky) approach of 1,062 ft. 6 in., and a north (Ohio) approach of 882 ft. 6 in. The river spans are continuous over the center pier and constitute the first large bridge of continuous type as well as the longest and heaviest fully riveted trusses in America. The trusses have a subdivided triangular web system with all joints riveted; gussets are of unusual size. The floor beams are U-shape with sides extending up the posts to the bottom of the swaybracing. Box plate-girder portals are provided over the end and middle piers. Deep lattice girders and curved knee brackets are used for traverse bracing.

The principal dimensions of the river spans are as follows:

Total length center to center of end bearings	1550 ft.
Span length center to center of bearings	775 ft.
Clear height above low water	106 ft. 6 in.
Clear height above high water	40 ft.
Height of trusses at center pier	129 ft. 2 in.
Height of trusses at ends	77 ft. 6 in.
Width between centers of trusses	38 ft. 9 in.
Panel length	38 ft. 9 in.

The large river spans were built for double track. The approach viaducts, each consisting of one 152 ft. 6 in. deck truss and 68 to 110 ft. plate girder spans were built, for the present, with steelwork for one track, while the masonry was built to accommodate a future second track.

The size and weight of individual parts in the bridge are as follows:

Heaviest chord member, 4 x 4½ x 77½ ft.; section, 596 sq. in.; weight, 119 tons.
Heaviest web member, 4 x 4½ x 75 ft.; section, 511 sq. in.; weight, 87 tons.
Largest gusset plates, 135 x 1⅝ in. x 14 ft. 9 in., and 140 x 1⅜ in. x 18 ft. 2 in.
Heaviest casting, 23 tons.
Largest rivets 1¼ in. diameter by 7⅜ in. grip.
Each center bearing carries dead load of 5,000 tons and live load of 3,000 tons.
Weight of steel in river spans only, 13,500 tons.

In order to meet the designer's specification that secondary stresses be eliminated from the finished structure under dead plus half live load, truss members were assembled before shipment with their normal angular relation toward each other at the joints and in this position all connections were either drilled from the solid or reamed. The members were bent into position in the field, computations having been made for each member.

The bridge was designed for E60 live loading on each track and a dead load of 18,800 lbs. per lineal foot of bridge. The material for the bridge is structural steel with ultimate strength 62,000 to 70,000 lbs per square inch.

ERECTION

The erection was carried on by means of a gantry traveler on falsework on the Ohio side and to point L18 on the Kentucky side. From this point the Kentucky span was erected as a cantilever by means of an overhead creeper to the Kentucky shore. However, heavy steel bents were used to support the trusses at L8 and L4 Kentucky, in order to reduce the otherwise excessive stresses in the trusses.

To allow for the passing of ice, driftwood, etc., falsework bents were used under only every other panel point on the Ohio side between L4 and L18, the approach girders being used to support the floor and gantry between these points.

Steel columns were provided at L16 and steel bents at L12, L8, and L4 on the Ohio side, to support the trusses. Between these points the trusses were carried on the falsework bents during erection.

With the Ohio trusses completed and having the end carried on jacks on the pier the steel columns and bends under the main panel points were of sufficient strength to carry the span, thereby allowing the removal of the timber in due course, or should the timber be swept out by river ice. The steel falsework was left under the span until sufficient of the Kentucky cantilever was erected to render the trusses self-supporting.

The floor and bottom laterals were placed first from the Ohio end to the center pier and to L18 Kentucky, and then the bottom chords were laid down in a straight line from L18 Kentucky, to the Ohio end, the floor assembled to them, riveted throughout in this position and jacked into cambered position, such that all the web members in turn connected to it without further jacking. This curve was practically the same as the no load camber of the completed bridge.

The trusses were erected from L18-U18 Kentucky, to L16-U18 Ohio by means of the gantry traveler, and then the overhead creeper was put up between U20 and U18, Kentucky. One panel was erected on the Kentucky side by the creeper traveler and the Ohio span was completed by the gantry. The Ohio span when completed rested on the steel bents at L4, 8, 12 and 16 and on wedge jacks on the Ohio end pier, this end being then 7⅝ in. low. The Kentucky span was erected to its center by the cantilever method and in this condition the Ohio end was jacked to release the steel columns and to place the 16 in. rockers under the end shoes.

After thus swinging the Ohio span, erection on the Kentucky side proceeded to L8, which point was jacked up 7⅜ in. with a force of 462,000 lbs. before the erection to L4 proceeded. With the truss erected to L4, the reaction at L8 was figured to be 2,000,000 lbs. Panel point L4 was jacked up 1 in. with a force of 384,000 lbs. and the erection continued to L0, at which time the reaction at L4 was figured to be 2,000,000 lbs. and at L8 1,195,000 lbs. In this condition the Kentucky end was 16 in. low and was jacked up with a force of 2,400,000 lbs. to bring it to its final elevation. During jacking the loads on bents L4 and L8 were relieved, and the 16 in. rockers were placed under the end shoes.

The Construction work on the foundations was started in November, 1914, and completed in October, 1915. Placing of falsework was begun in May, 1916, and erection of steel in June, 1916. The bridge was ready for traffic in August, 1917.

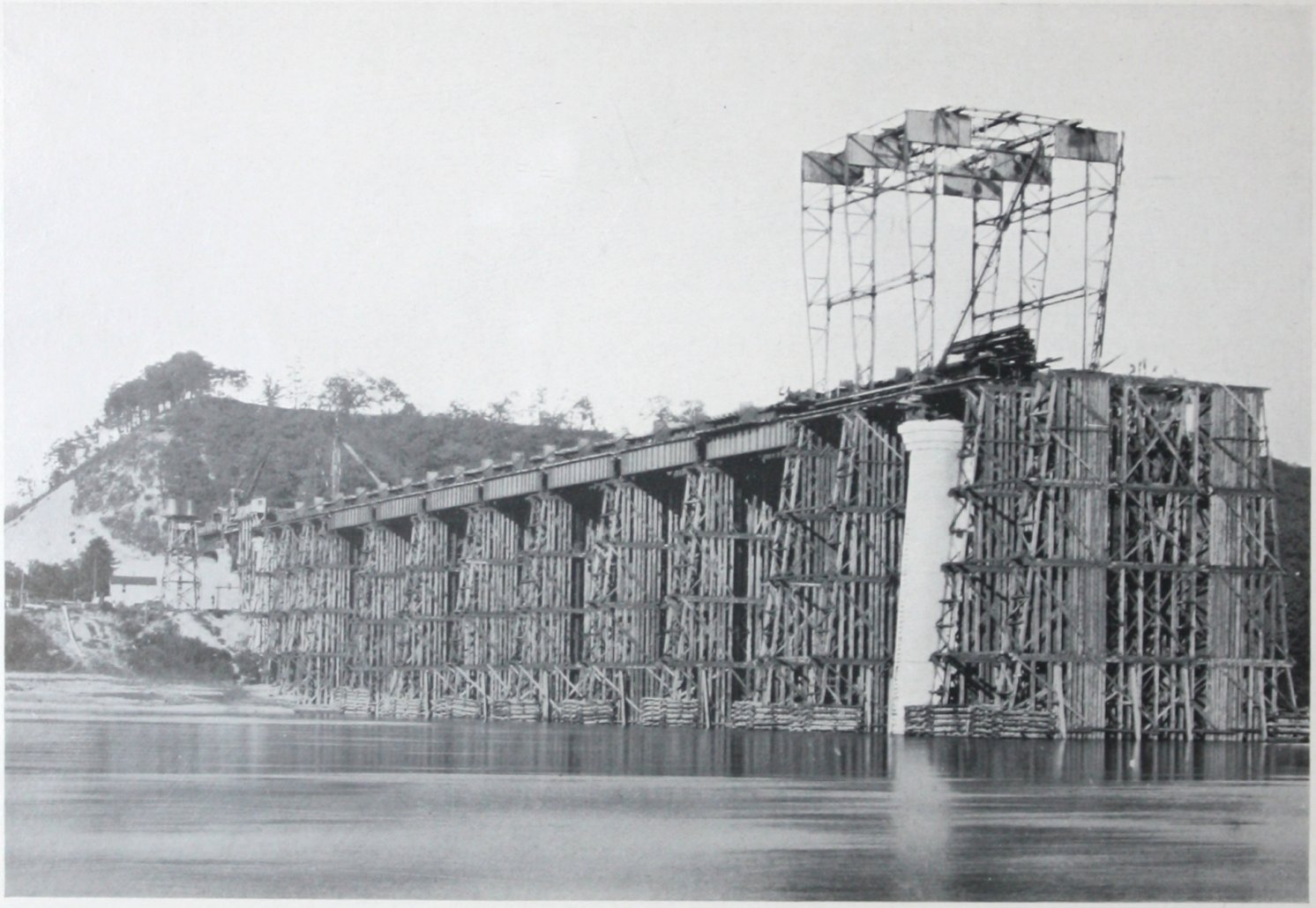
RESULTS

Previous to erection extensive computations were made to determine the amount holes would mismatch at every panel point and the forces required to bring them to match, and for the deflections and jacking forces of the truss as a whole at the various temporary and permanent supports. It is worthy of note that in all but three minor cases the actual results agreed with the computed. Two sets of computations were made, one using 20% allowance for the effect of details and one with no allowance. The actual results closely corresponded with a 10% allowance.

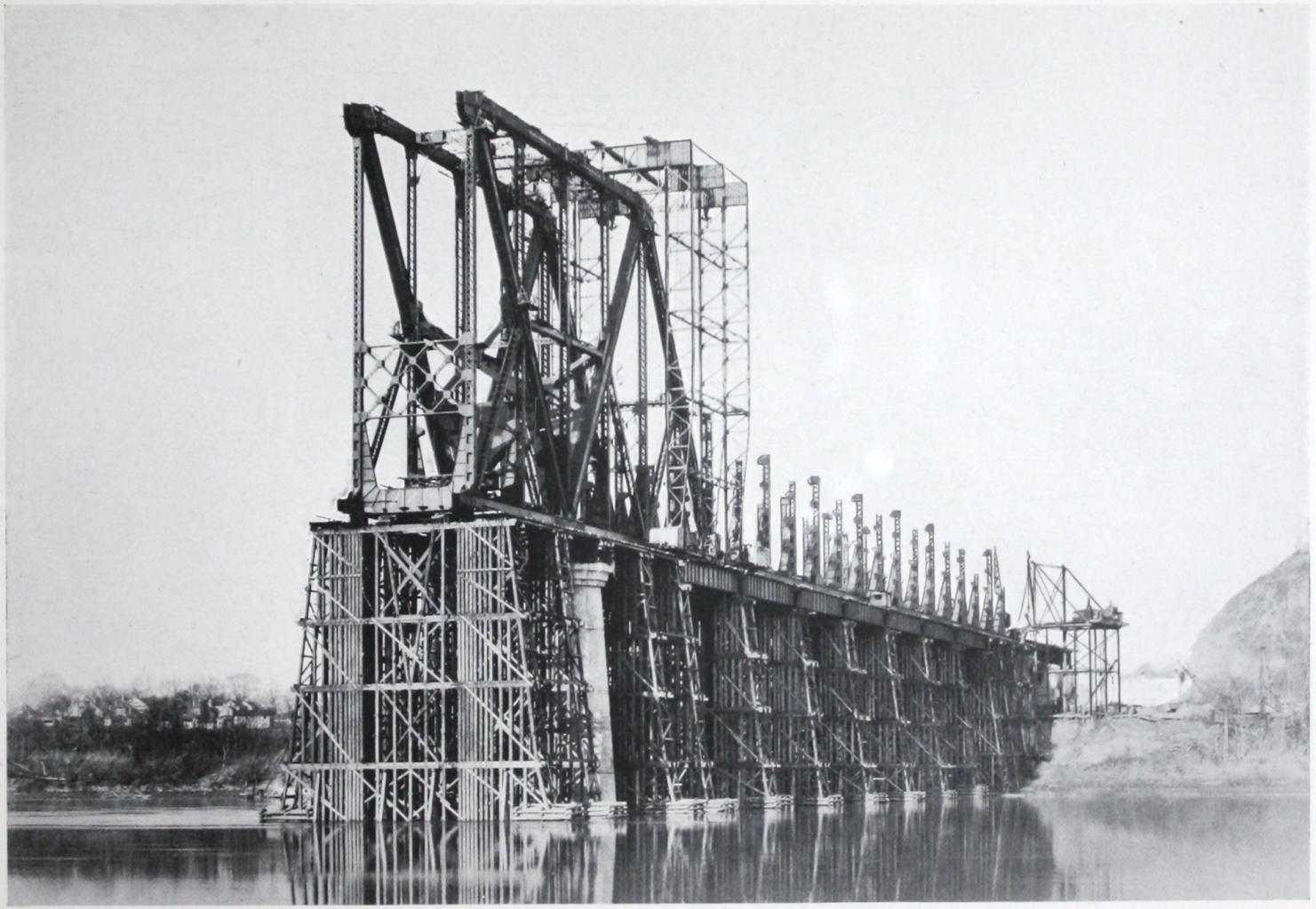
The erection of members, with perfectly matched holes at one end, and afterward jacking or pulling the other end to connect in order to eliminate secondary stresses from the finished structure under dead plus half live load, was carried out in accordance with the program developed from the calculations. The devices, some of which are pictured in this booklet, performed their work in a satisfactory manner and proved adequate for the conditions encountered, and, as the difficulties had been foreseen, no unexpected delays resulted in the progress of erection on account of the work involved in these operations.

A change in elevation of one end of the bridge of 1 in. changes the reaction only 7.5 tons, showing that possible slight settlement of the piers or inaccurate setting of the shoes cannot have a serious effect on a long continuous structure.

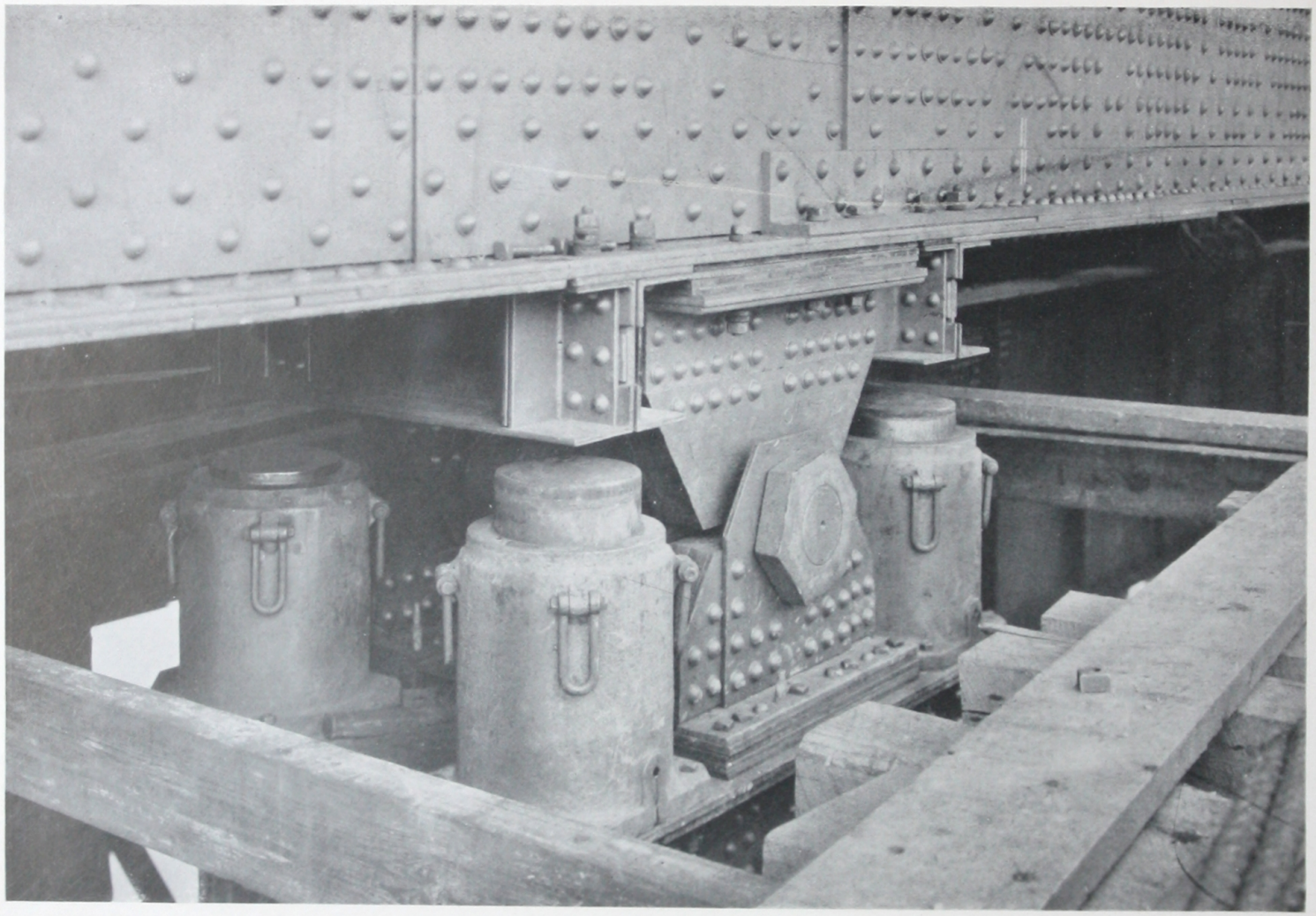
The design and detail plans of the bridge and approaches were made by Mr. Gustav Lindenthal, Consulting and Chief Engineer. The foundations and masonry were built by the Dravo Contracting Company of Pittsburgh, and the steel superstructure was fabricated and erected by the McClintic-Marshall Company of Pittsburgh.



OHIO SPAN—Falsework completed,—1,250,000 Ft. B. M. used. Gantry traveler 60 ft. high with two 80 ft. booms used to set falsework, floor and lower chord.



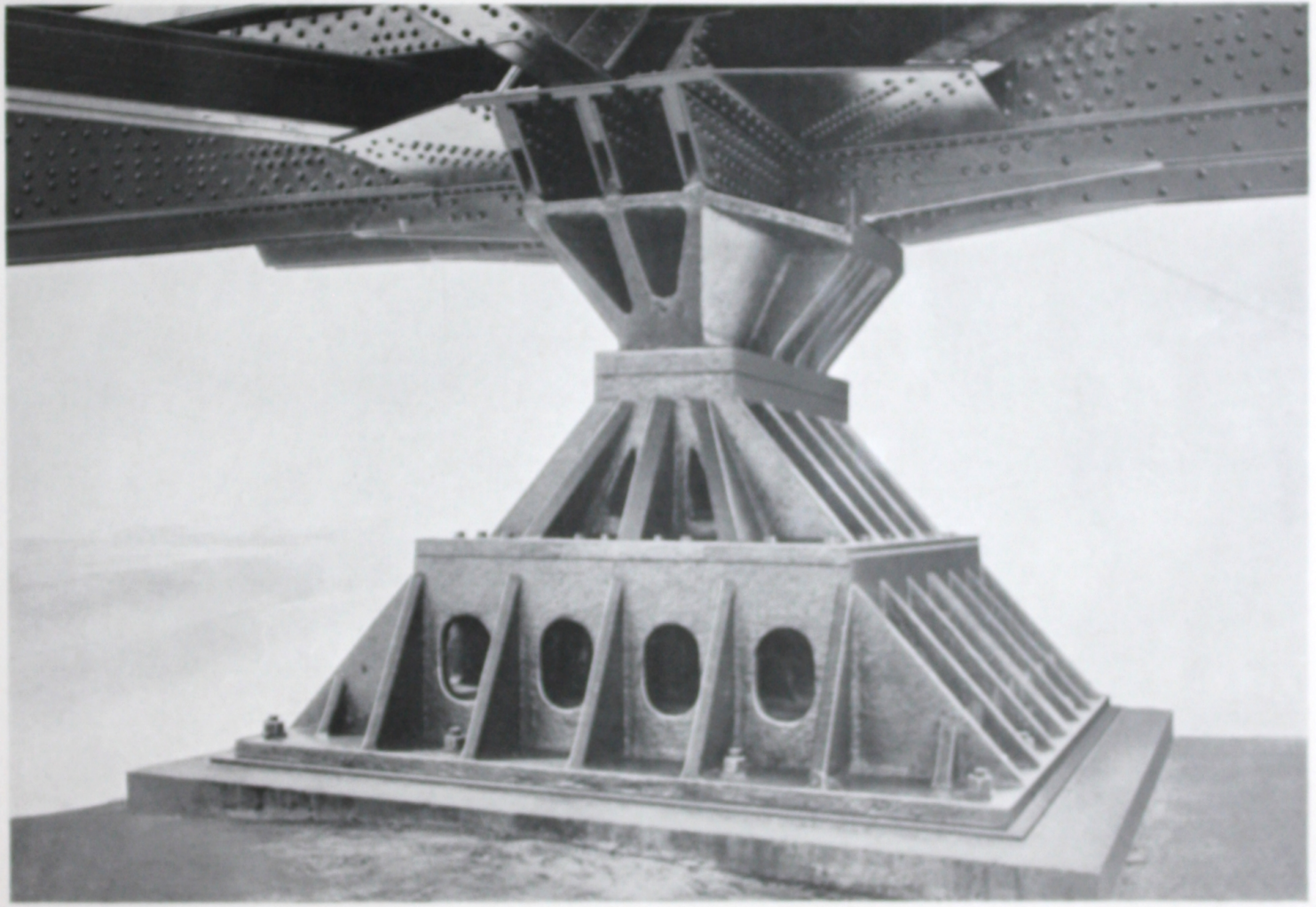
OHIO SPAN—Ohio span erected to L-16 and Kentucky span erected to L-18.



OHIO SPAN—Showing hydraulic jacks and rocker shoes on top of steel falsework columns.

OHIO SPAN—Showing wedge jacks supporting lower chord on top of timber falsework towers.

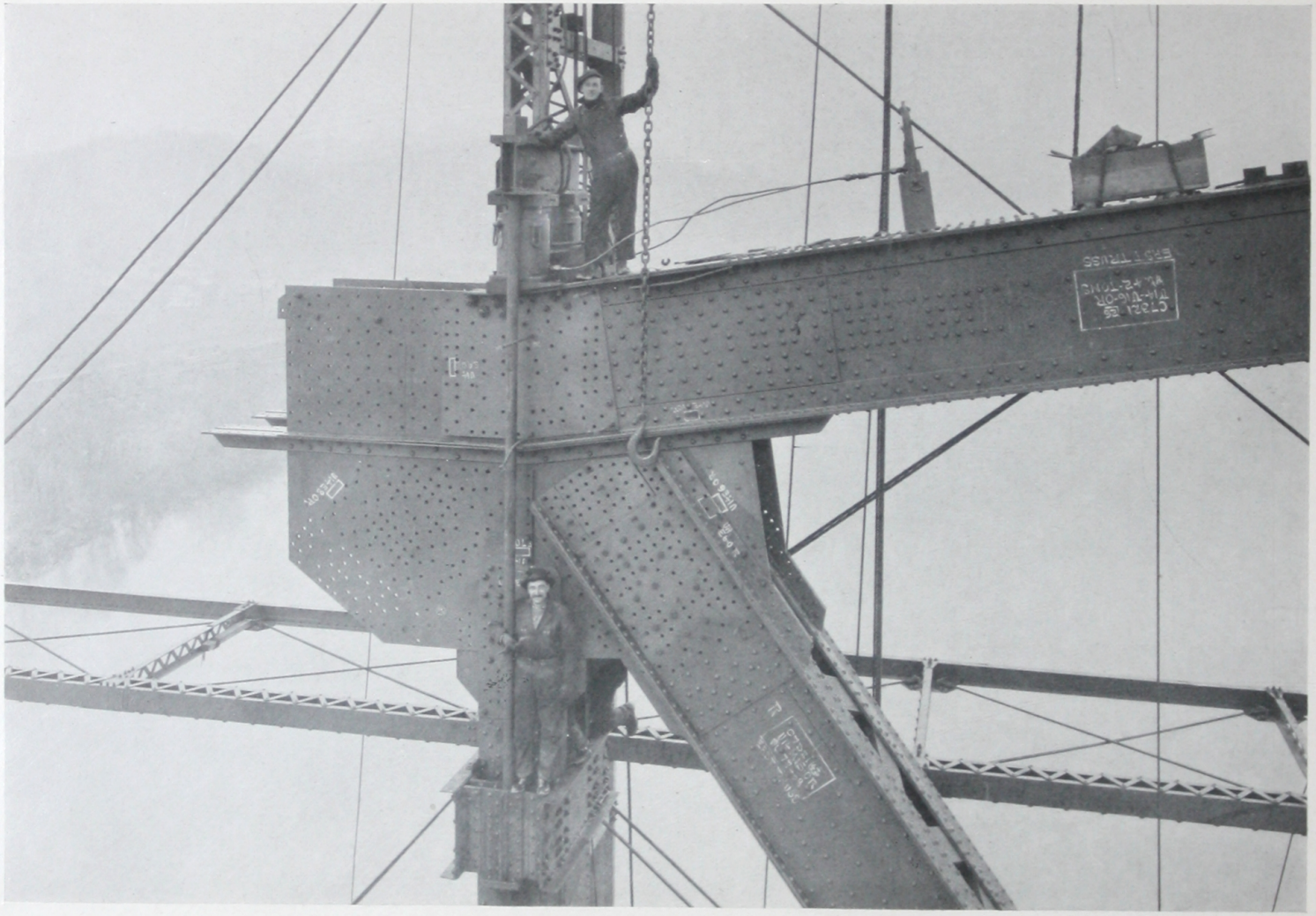
CENTER PIER—Setting center lower chord section with gussets over center pier bearing. Weight 40 tons.



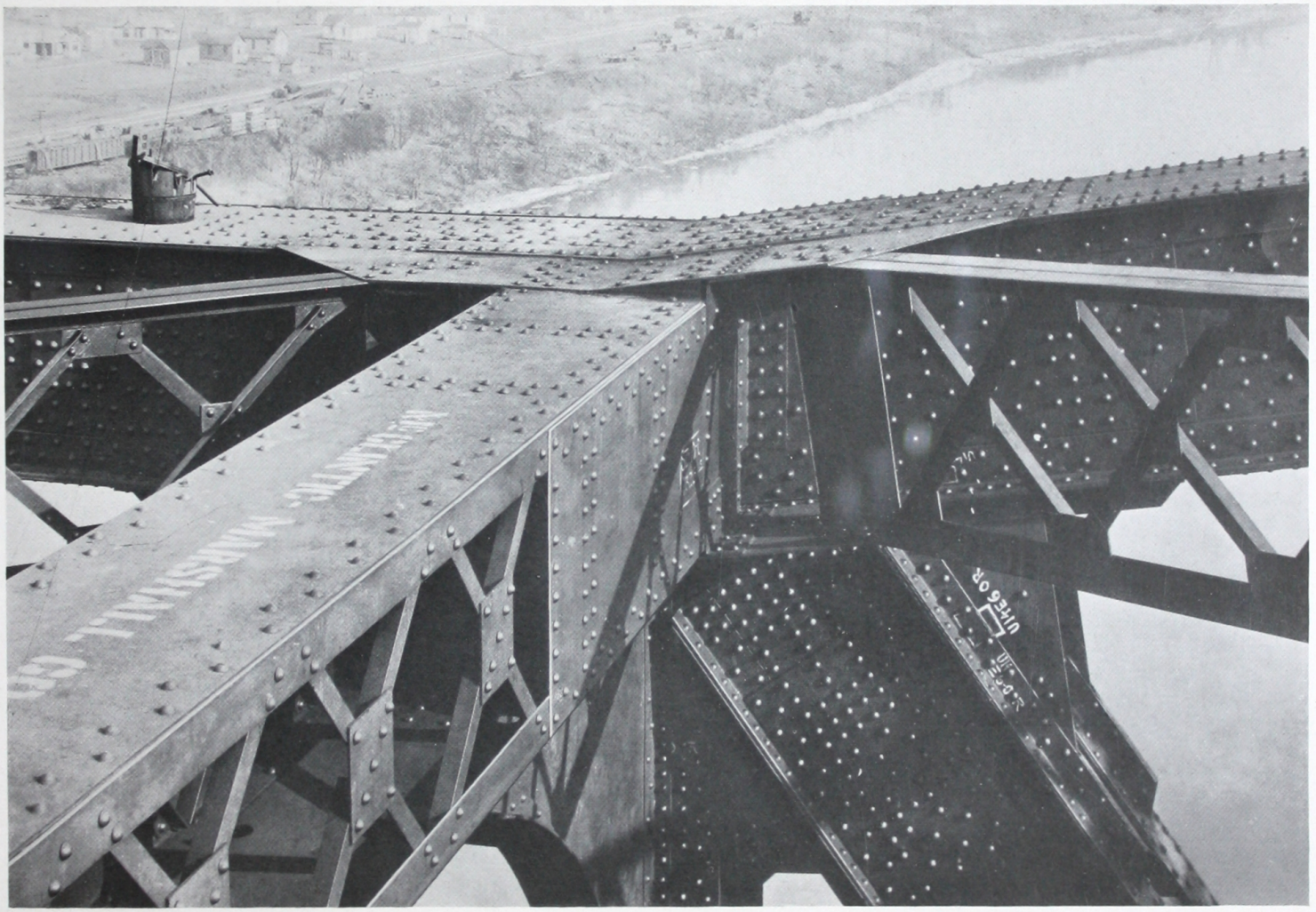
CENTER PIER BEARING—Base 14 ft. square. Total weight 71 tons.

OHIO SPAN—Showing special lifting devices used on all main members.

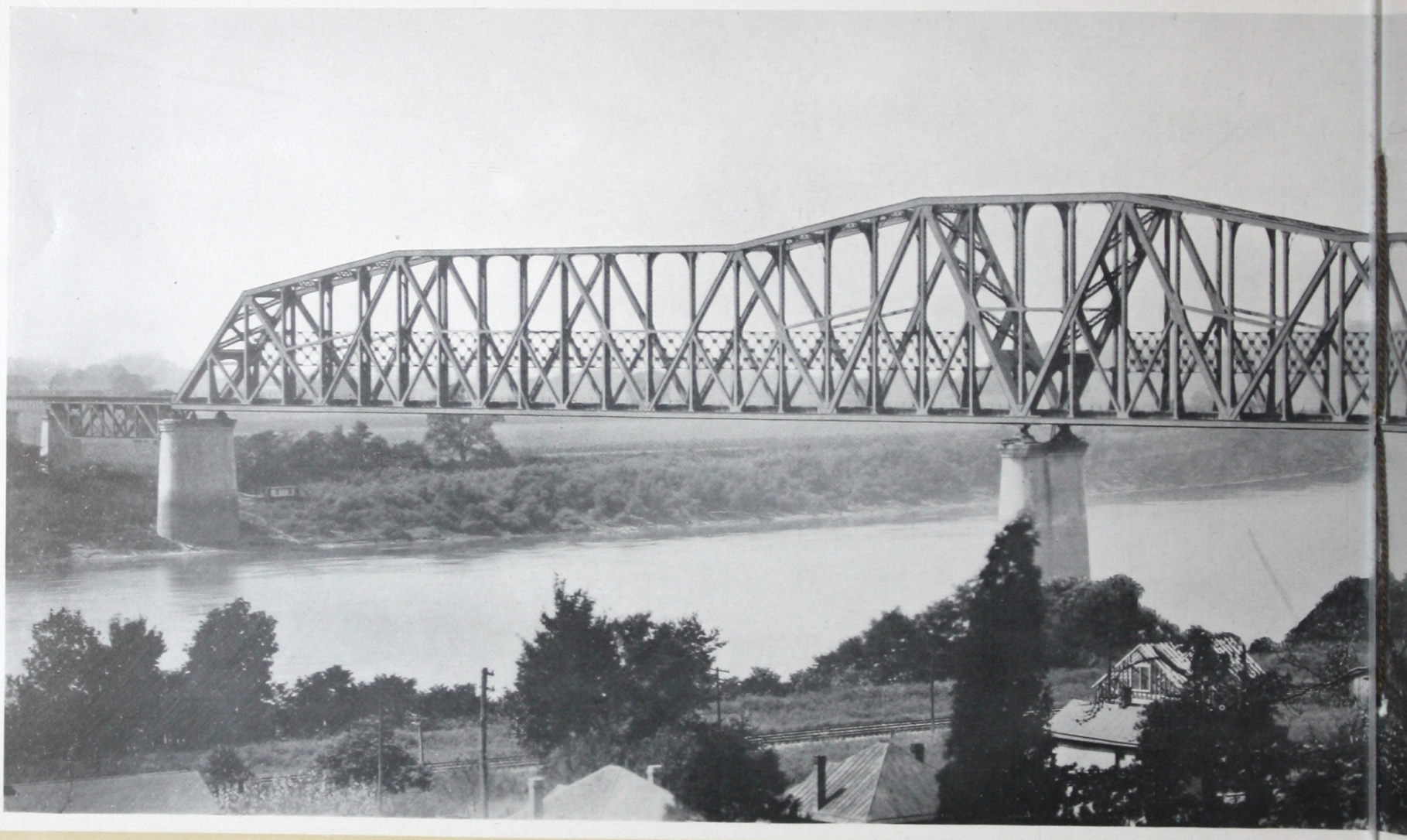
OHIO SPAN—Members for both trusses being lifted simultaneously by falls from gantry traveler.



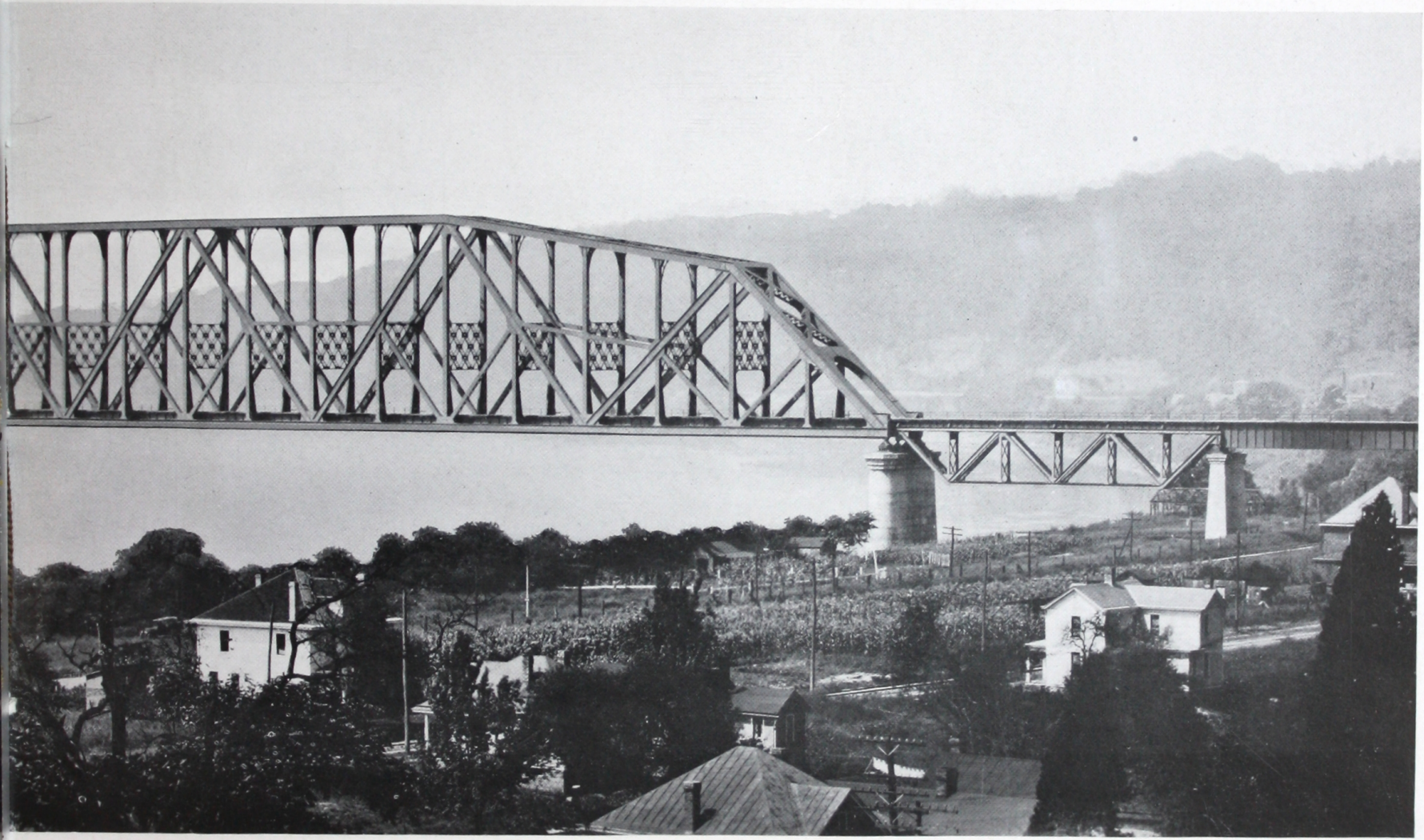
OHIO SPAN—Hydraulically operated devices used to force matching of connection holes between upper chord gussets and vertical member at U-14.



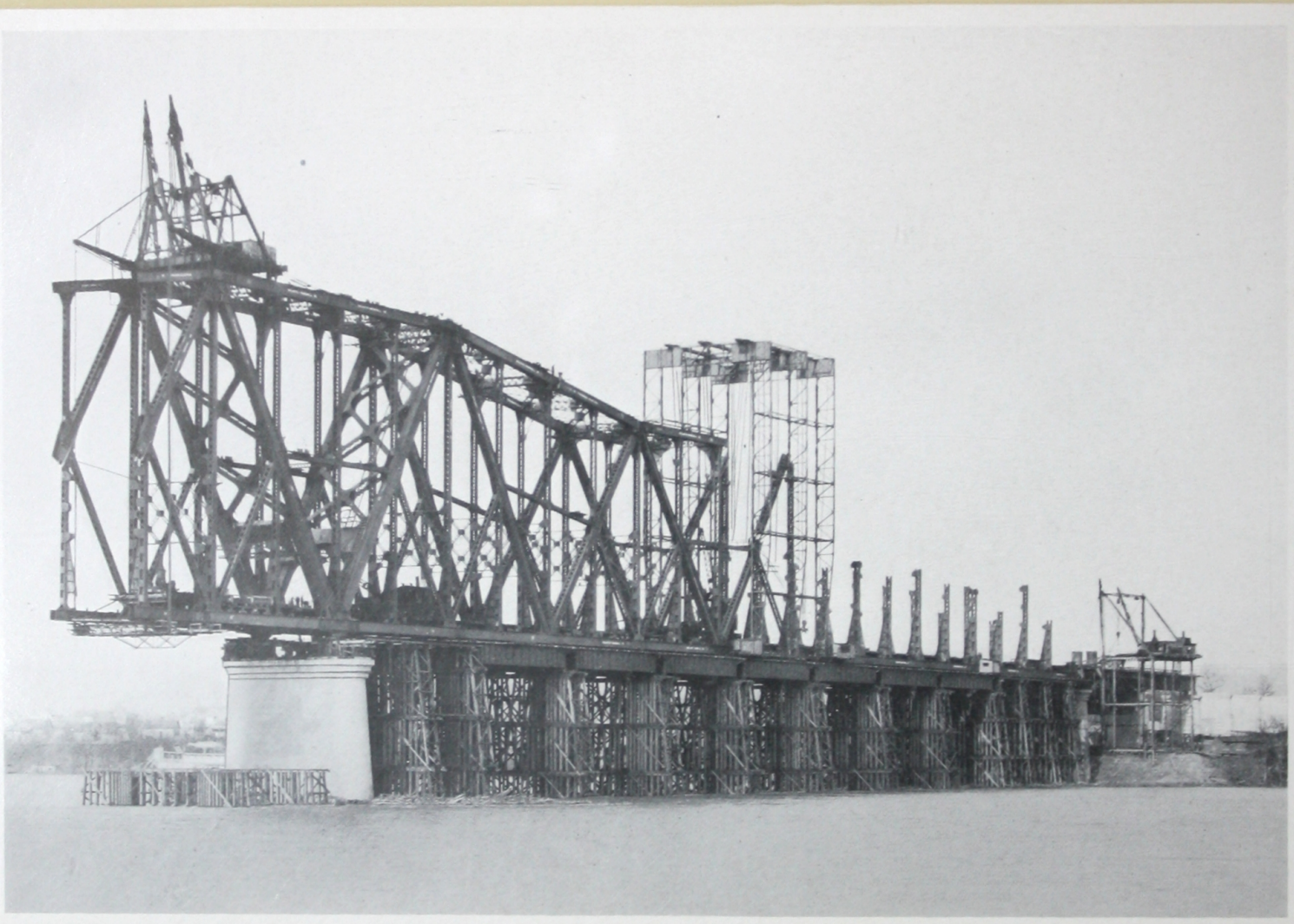
OHIO SPAN—Finished panel point at U-14 showing connection of top laterals to trusses.



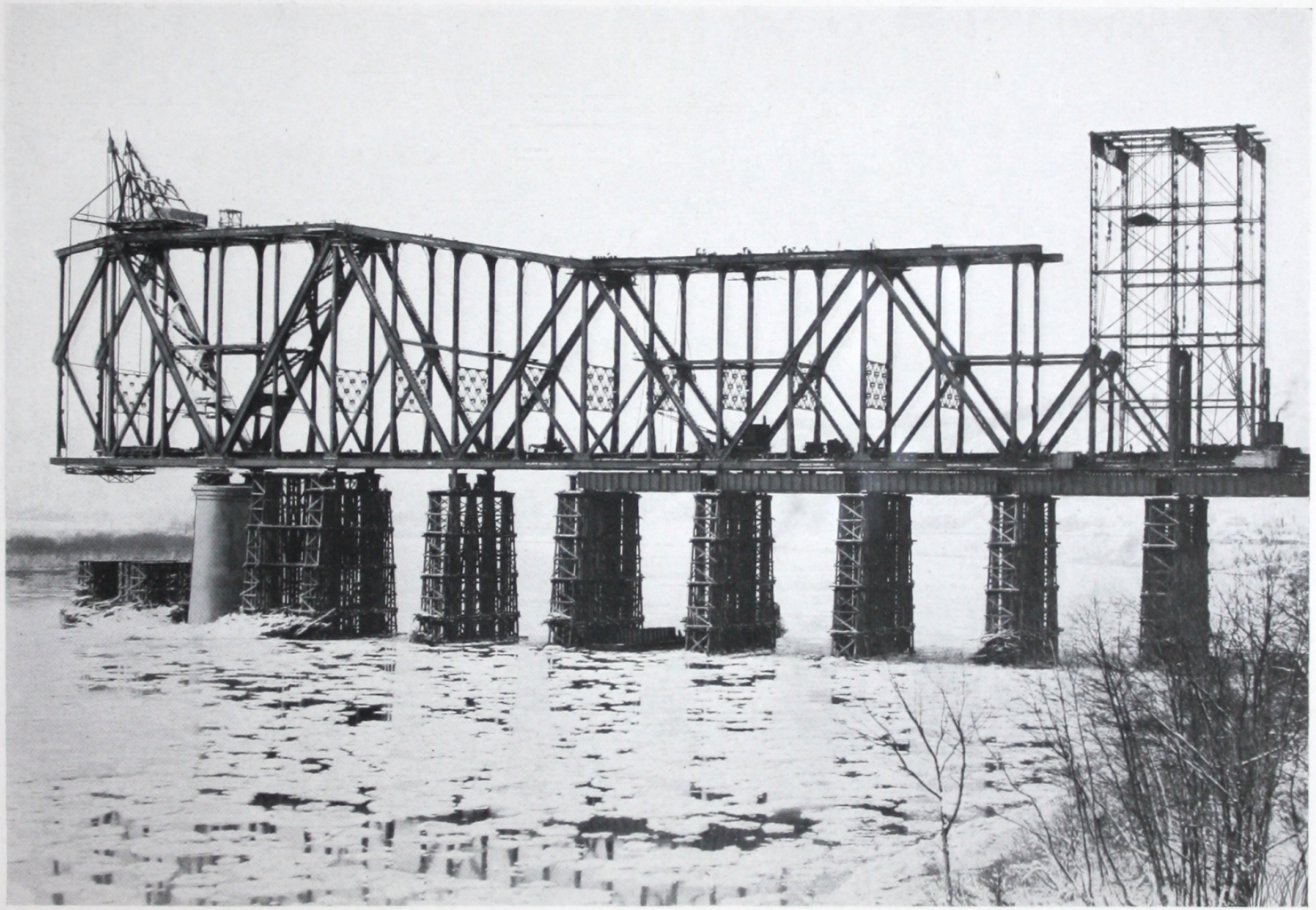
SCIO VILL



T VILLE BRIDGE



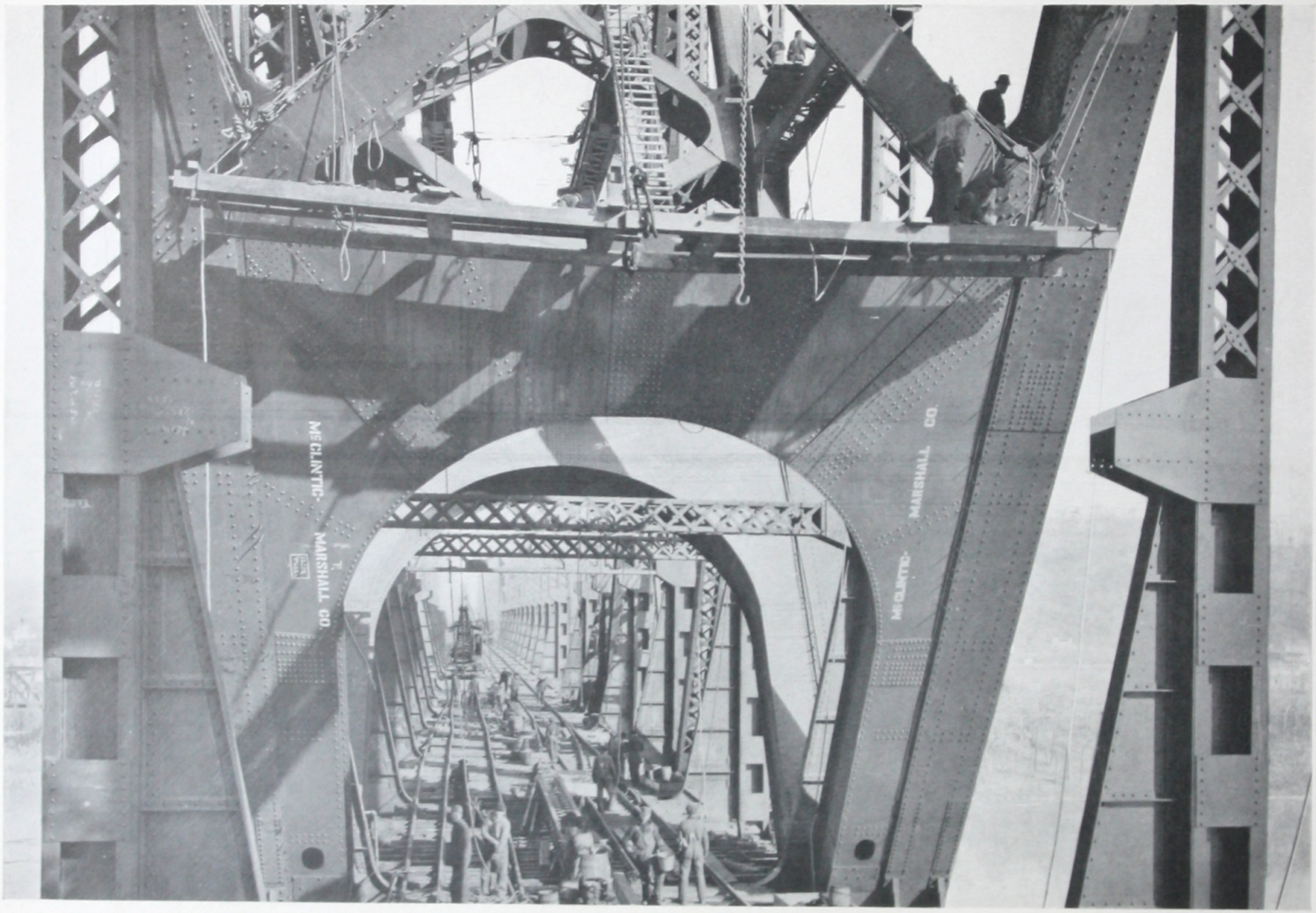
OHIO SPAN—Gantry traveler erecting Ohio span and creeper traveler completing third panel of the Kentucky span.



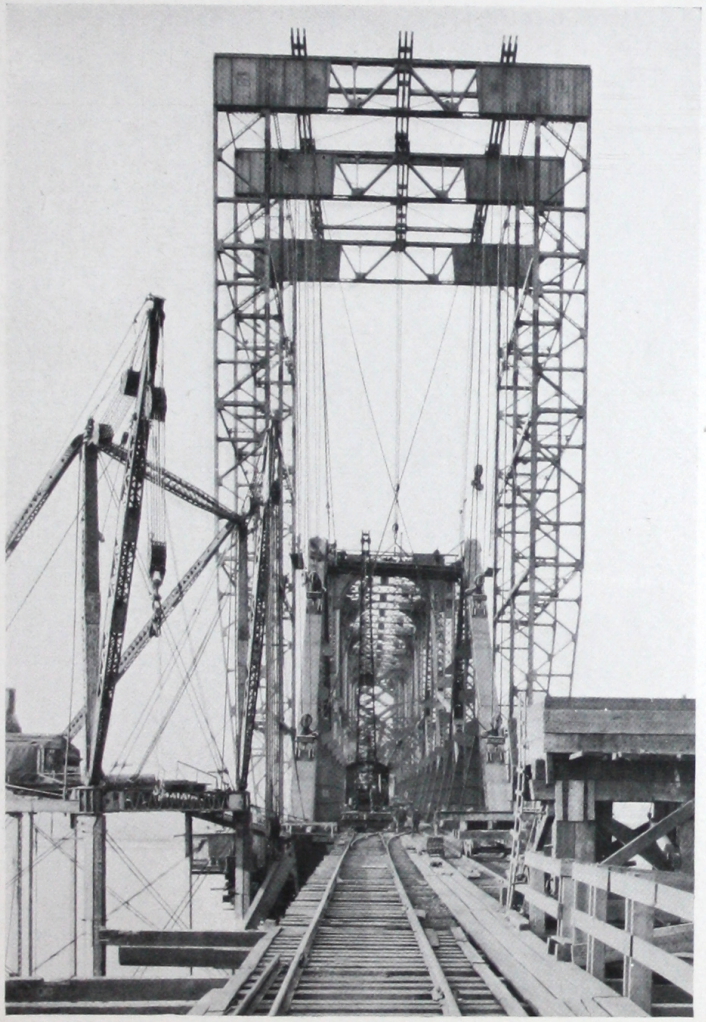
OHIO SPAN—Showing ice passing through 65 ft. openings of falsework.

OHIO SPAN—View from Kentucky side showing Ohio span swung free from falsework which is partially removed.

KENTUCKY SPAN—Erecting steel falsework bent at L-8. Kentucky span cantilevered 426 ft. 3 in.



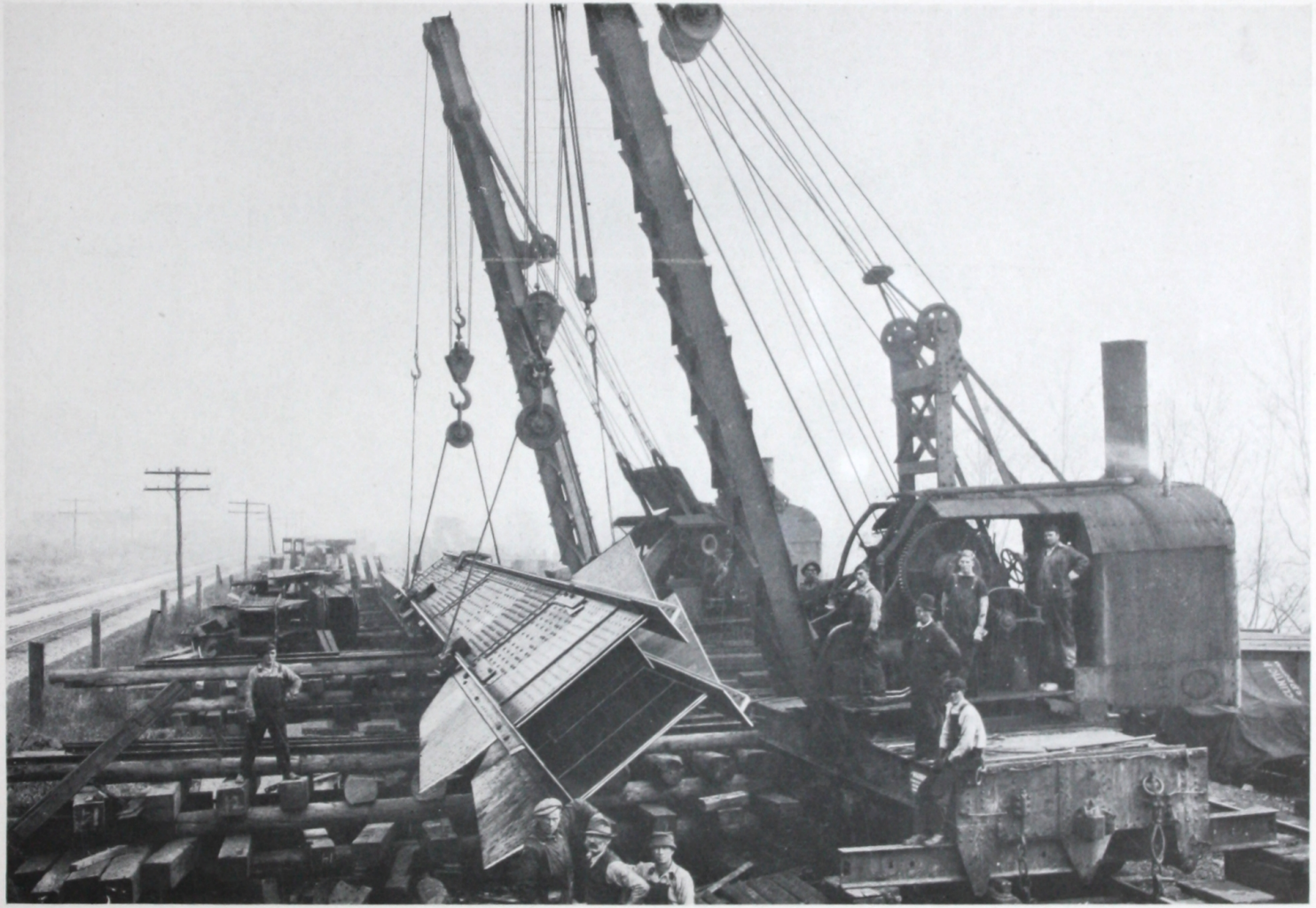
CENTER PIER.—Riveted plate portals at junction of Ohio and Kentucky spans.



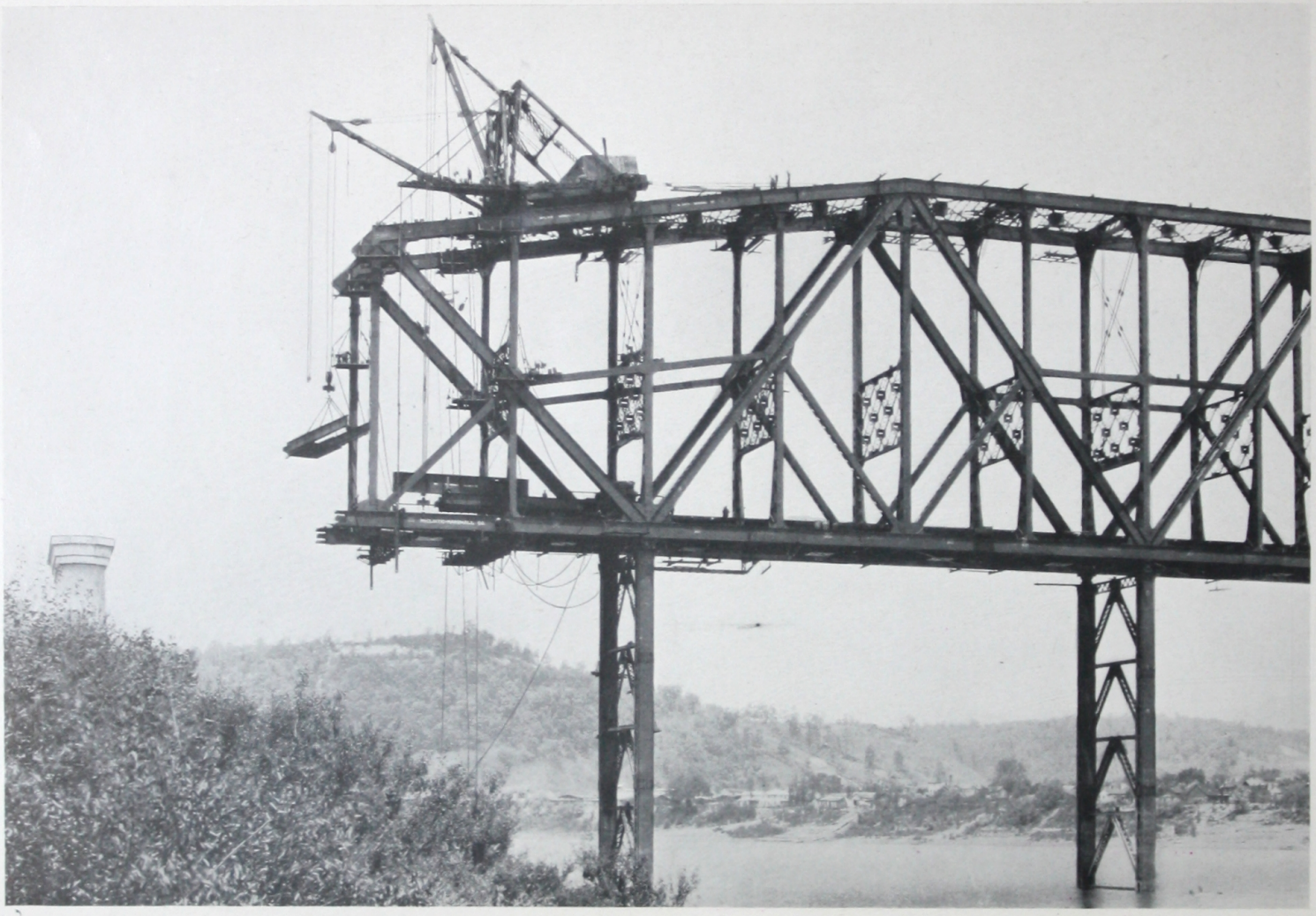
OHIO SPAN—Gantry traveler 160 ft. high setting the end posts; at left 2-boom lifting tower used to hoist steel from storage yard to bridge deck.

KENTUCKY SPAN—Showing Kentucky span with panel points L-8 resting on steel tower after being cantilevered 465 ft.

KENTUCKY SPAN—Steel cable falls used to connect main diagonal to top chord gusset.
Also showing riveting scaffolds with safety railings.

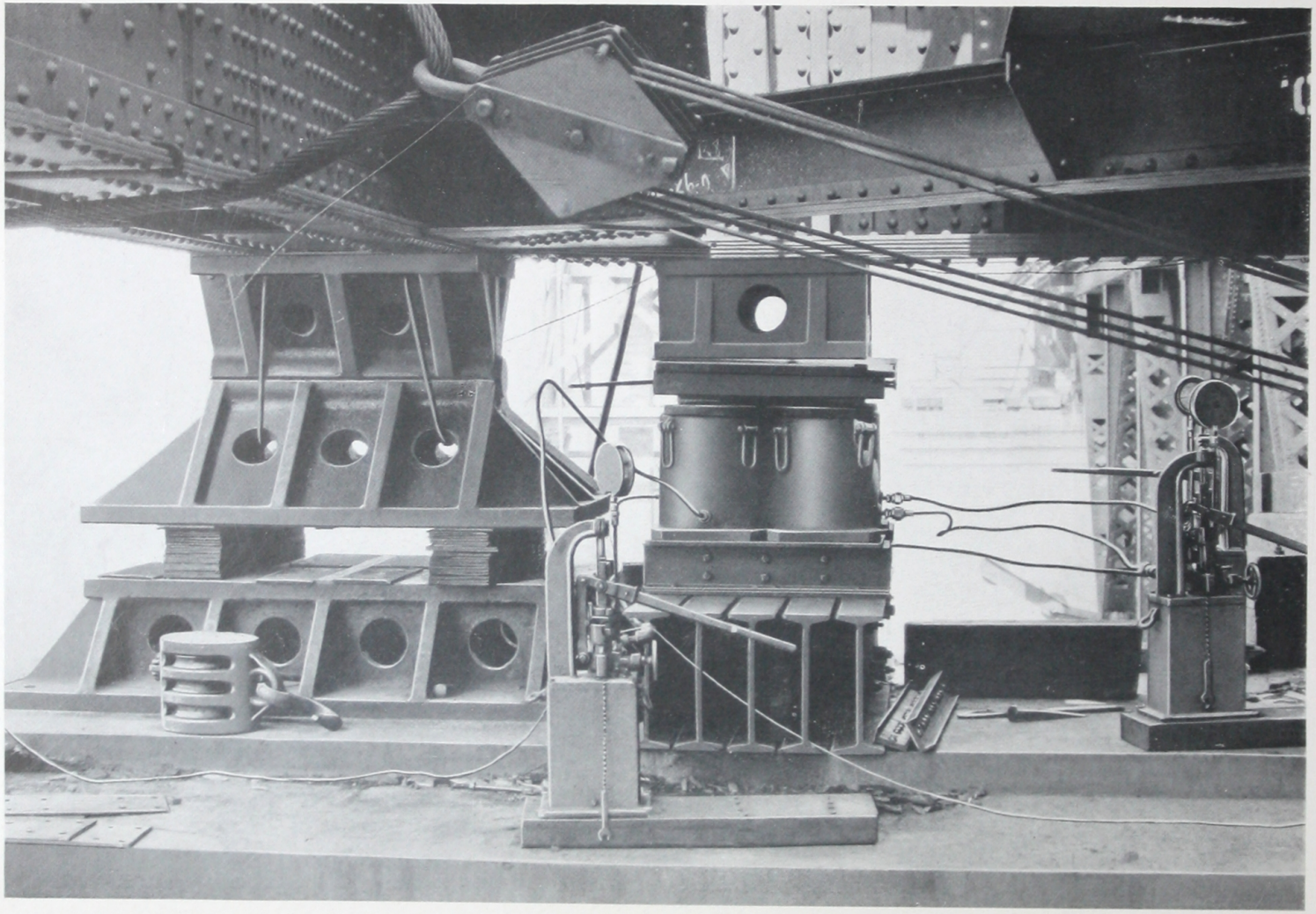


Method of turning main truss members in storage yard before sending them to the travelers.

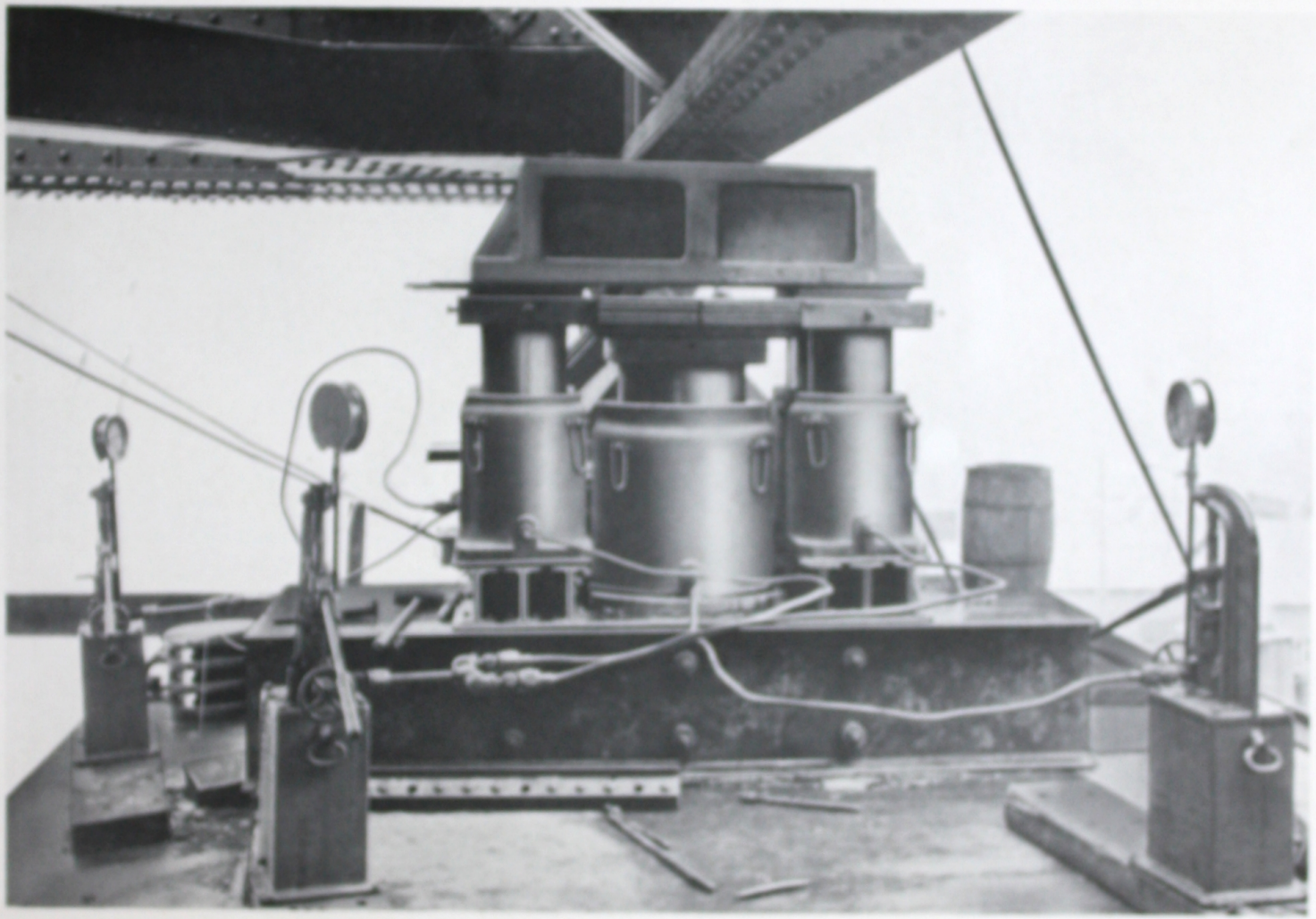


KENTUCKY SPAN—Showing creeper traveler and steel falsework bents at L-8 and L-4.

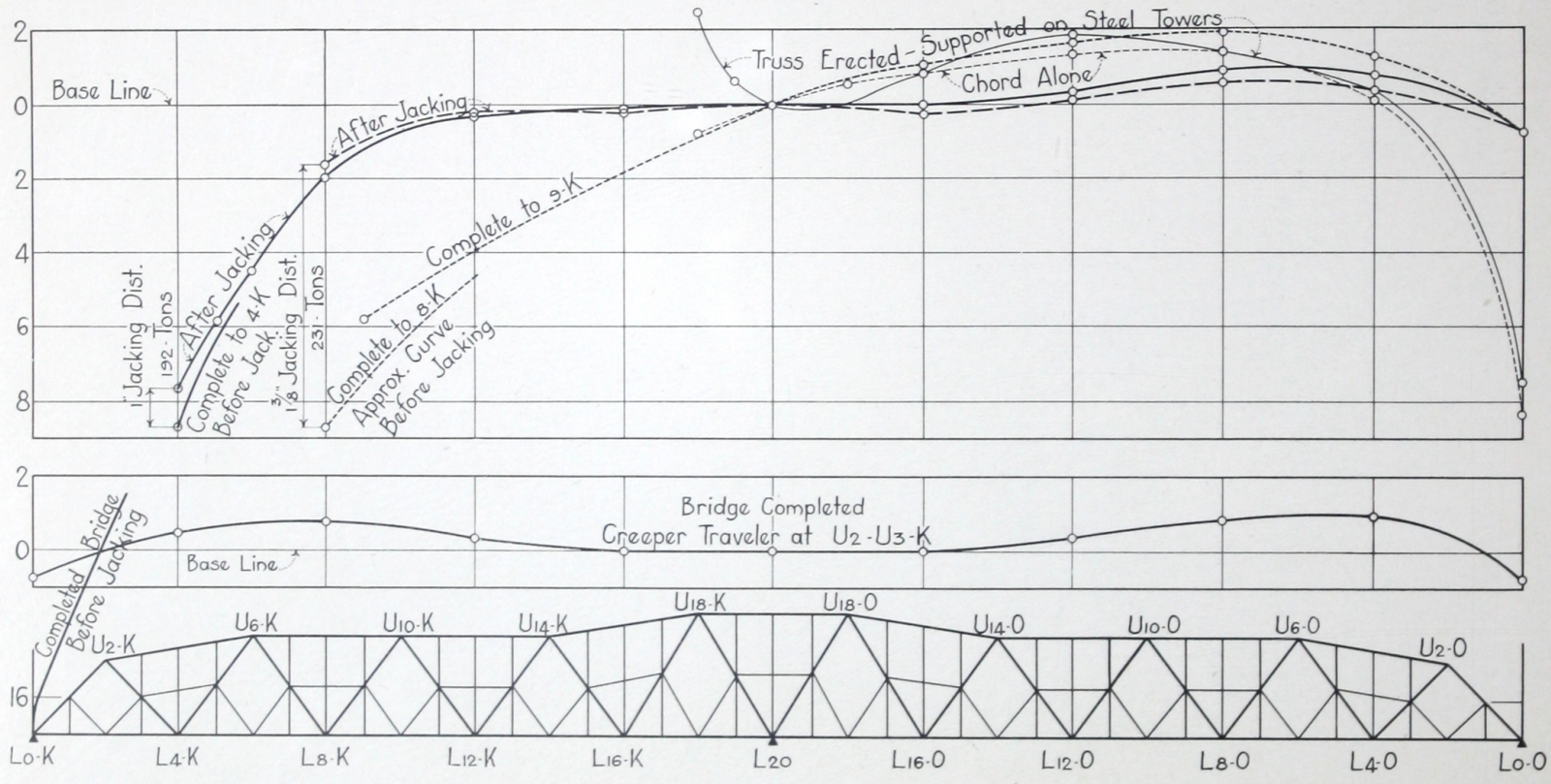
SCIOTOVILLE BRIDGE—Completed to Kentucky pier.



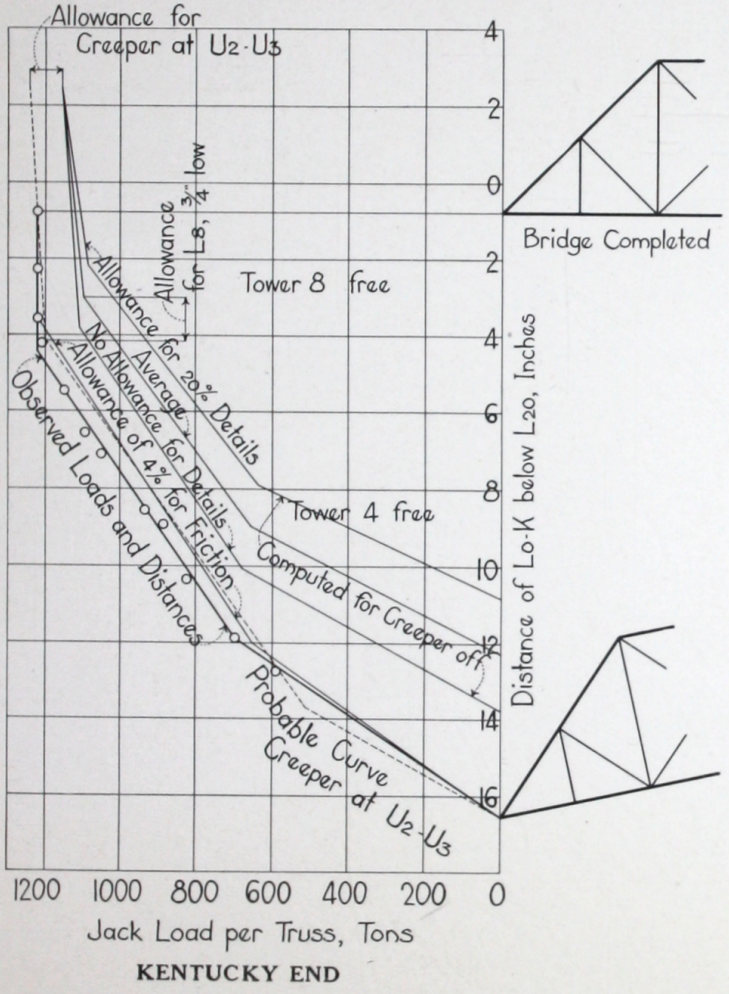
OHIO SPAN—View showing end bearing and jacks used to raise end of bridge to final elevation and to insert rockers.



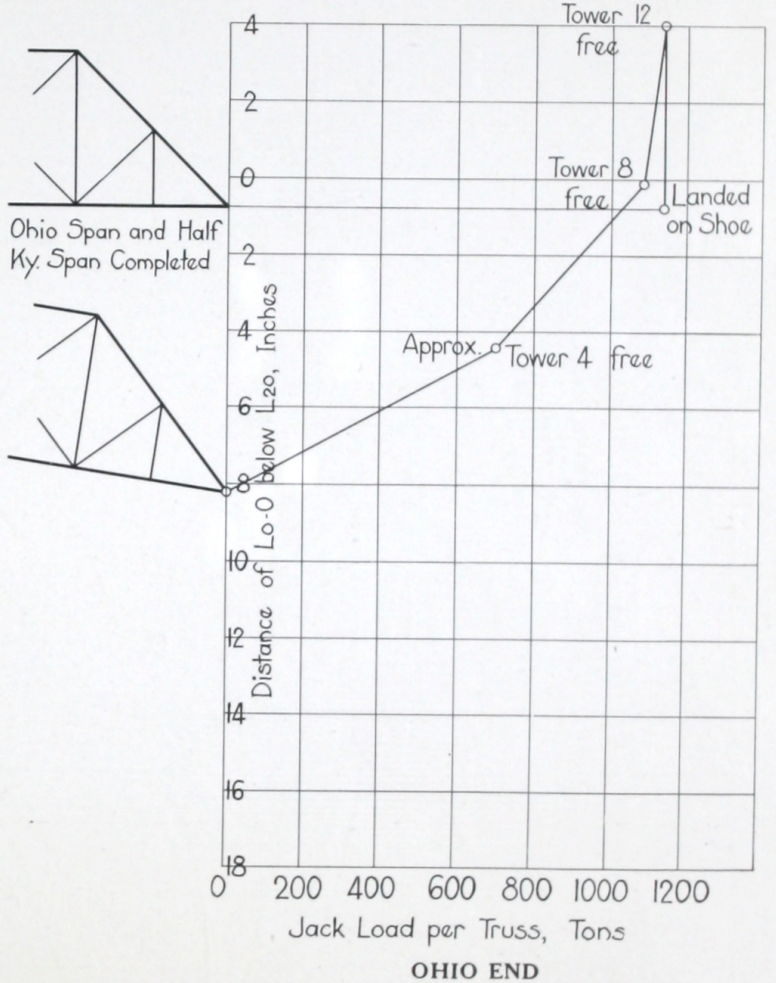
SWINGING SPAN—View showing arrangement of one 500-ton and four 200-ton hydraulic jacks used under each end of end floor beams to swing both spans.



Curves of lower chord under various erection conditions.



KENTUCKY END



OHIO END

Relation between load and jacking distance while swinging spans.